

FORM PTO 1390
(REV 5-93)

US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY DOCKET NUMBER
2001_0210ATRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. §371U.S. APPLICATION NO.
(if known, see 37 CFR 1.55)
09/763964International Application No.
PCT/JP00/04967 ✓International Filing Date
July 26, 2000 ✓Priority Date Claimed
July 27, 1999 ✓Title of Invention
ANTI-MICROBIAL STERILIZER AND REFRIGERATOR HAVING ITApplicant(s) For DO/EO/US
Kahoru TSUJIMOTO ✓


Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. §371.
 2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. §371.
 3. ☒ This express request to begin national examination procedures (35 U.S.C. §371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. §371(b) and PCT Articles 22 and 39(1).
 4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
- ☒ A copy of the International Application as filed (35 U.S.C. §371(c)(2))
- a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau). ATTACHMENT A
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. §371(c)(2)). ATTACHMENT B
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3)).
- a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19.
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. §371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. §371(c)(5)).

Items 11. to 14. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98. ATTACHMENT C
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment. ATTACHMENT D
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☒ Other items or information:
 - Notification Concerning Submission or Transmittal of Priority Document - ATTACHMENT E
 - unexecuted Declaration and Power of Attorney with Cover Letter - ATTACHMENT F

THE COMMISSIONER IS AUTHORIZED
TO CHARGE ANY DEFICIENCY IN THE
FEES FOR THIS PAPER TO DEPOSIT
ACCOUNT NO. 23-0975

U.S. APPLICATION NO. 09/763964		INTERNATIONAL APPLICATION NO. PCT/JP00/04967		ATTORNEY'S DOCKET NO. 2001 0210A					
15. [X] The following fees are submitted BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee nor international search fee paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00 International Search Report has been prepared by the EPO or JPO \$ 860.00 International preliminary examination fee not paid at USPTO but international search paid to USPTO \$ 710.00 International preliminary examination fee paid to USPTO but claims did not satisfy provisions of PCT Article 33(1)-(4) \$ 690.00 International preliminary examination fee paid at USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$ 100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">CALCULATIONS</th> <th style="width: 50%;">PTO USE ONLY</th> </tr> <tr> <td style="height: 100px; vertical-align: bottom;">\$860.00</td> <td></td> </tr> </table>		CALCULATIONS	PTO USE ONLY	\$860.00	
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Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">\$</td> <td style="width: 50%;"></td> </tr> </table>		\$			
\$									
Claims	Number Filed	Number Extra	Rate						
Total Claims	16 - 20 =	0	X \$18.00	\$					
Independent Claims	1 - 3 =	0	X \$80.00	\$					
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$					
TOTAL OF ABOVE CALCULATIONS =				\$860.00					
<input type="checkbox"/> Small Entity Status is hereby asserted. Above fees are reduced by 1/2.				\$					
SUBTOTAL =				\$860.00					
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	\$				
TOTAL NATIONAL FEE =				\$860.00					
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40 per property				+	\$				
TOTAL FEES ENCLOSED =				\$860.00					
				Amount to be refunded	\$				
				Amount to be charged	\$				
a. [X] A check in the amount of \$860.00 to cover the above fees is enclosed. A duplicate copy of this form is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 23-0975 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-0975.									
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.									
19. CORRESPONDENCE ADDRESS <div style="text-align: center;">  000513 PATENT TRADEMARK OFFICE </div>			By: <u>Charles R. Watts</u> Charles R. Watts, Registration No. 33,142 WENDEROTH, LIND & PONACK, L.L.P. 2033 "K" Street, N.W., Suite 800 Washington, D.C. 20006 Phone: (202) 721-8200 Fax: (202) 721-8250 February 28, 2001						

[CHECK NO. 43241]

[2001_0210A]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :
Kahoru TSUJIMOTO et al. : Attn: BOX PCT
Serial No. NEW : Docket No. 2001_0210A
Filed February 28, 2001 :

ANTI-MICROBIAL STERILIZER AND
REFRIGERATOR HAVING IT

[Corresponding to PCT/JP00/04967
Filed July 26, 2000]

PRELIMINARY AMENDMENT TO REDUCE PTO FILING FEE

Assistant Commissioner for Patents,
Washington, DC 20231

Sir:

Please amend the above-identified application as follows.

In the Claims:

Kindly amend claims 3, 4, 7, 10 and 13 as follows.

3. (Amended) The sterilizer according to claim 1, wherein said capsule is thermally double-sealed at both ends thereof.

4. (Amended) The sterilizer apparatus according to claim 1, wherein said base ingredient of said anti-microbial material is doped with a low-temperature thermoset substance for increasing a viscosity.

7. (Amended) The sterilizer according to claim 1, wherein the anti-microbial material further includes two types of said aromatic substance.

10. (Amended) The sterilizer according to claim 5, wherein a space is provided between said film and the surface of said container where the ventilation apertures are provided.

13. (Amended) The refrigerator according to claim 11, wherein said anti-microbial material includes an aromatic substance.

Kindly add new claims 14-16 as follows.

14. (New) The sterilizer according to claim 6, wherein a space is provided between said film and the surface of said container where the ventilation apertures are provided.

15. (New) The sterilizer according to claim 7, wherein a space is provided between said film and the surface of said container where the ventilation apertures are provided.

16. (New) The refrigerator according to claim 12, wherein said anti-microbial material includes an aromatic substance.

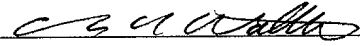
REMARKS

The above claim amendments are presented in order to remove multiple claim dependencies, so as to reduce the required filing fee.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

Respectfully submitted,

Kahoru TSUJIMOTO et al.

By 
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Registration No. 33,142
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Telephone (202) 721-8200
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February 28, 2001

VERSION WITH MARKINGS TO SHOW CHANGES MADE

3. (Amended) The sterilizer according to claim 1 [or 2], wherein said capsule is thermally double-sealed at both ends thereof.

4. (Amended) The sterilizer apparatus according to claim 1, [2, or 3,] wherein said base ingredient of said anti-microbial material is doped with a low-temperature thermoset substance for increasing a viscosity.

7. (Amended) The sterilizer according to claim [5] 1, wherein the anti-microbial material further includes two types of said aromatic substance.

10. (Amended) The sterilizer according to claim 5, [6, or 7,] wherein a space is provided between said film and the surface of said container where the ventilation apertures are provided.

13. (Amended) The refrigerator according to claim 11 [or 12], wherein said anti-microbial material includes an aromatic substance.

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JC07 Rec'd PCT/PTO

18 APR 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of : **ATTN: BOX PCT**
Kahoru TSUJIMOTO et al. : Docket No. 2001-0210A
Serial No. 09/763,964 :
Filed February 28, 2001 :
ANTI-MICROBIAL STERILIZER :
AND REFRIGERATOR HAVING IT :

**THE COMMISSIONER IS AUTHORIZED
TO CHARGE ANY DEFICIENCY IN THE
FEE FOR THIS PAPER TO DEPOSIT
ACCOUNT NO. 23-0975.**

SUPPLEMENTAL PRELIMINARY AMENDMENT

Assistant Commissioner for Patents,
Washington, D.C.

Sir:

Prior to examination of the present application, kindly further amend the above-identified U.S. patent application as follows:

In the Title:

Kindly change the title to read "ANTI-MICROBIAL STERILIZER AND REFRIGERATOR HAVING ANTI-MICROBIAL STERILIZER".

In the Specification and Abstract:

Kindly replace the original specification and abstract with the enclosed substitute specification and abstract.

09/763,964-0501

In the Claims:

Kindly amend claims 1-3 and 6-15 as follows:

1. (Amended) A sterilizer comprising:
an anti-microbial material including a base ingredient and a volatile anti-microbial agent impregnated in said base ingredient;
an air-permeable capsule encapsulating said anti-microbial material;
a container having ventilation apertures provided in a surface thereof, said capsule being accommodate within said container; and
a peelable film provided over said surface of said container having said ventilation apertures.
2. (Amended) The sterilizer according to claim 1, wherein a space is provided between said capsule and said surface of said container having said ventilation apertures.
3. (Amended) The sterilizer according to claim 1, wherein said capsule is double-sealed at both ends thereof.
6. (Amended) The sterilizer according to claim 5, wherein said anti-microbial material includes a higher concentration of said aromatic substance than said anti-microbial agent.
7. (Amended) The sterilizer according to claim 1, wherein said anti-microbial material further includes two aromatic substances.
8. (Amended) The sterilizer according to claim 5, wherein said aromatic substance is an herb-type aromatic substance.
9. (Amended) The sterilizer according to claim 7, wherein said two aromatic substances include a herb-type aromatic substance and a citrus-type aromatic substance.

10. (Amended) The sterilizer according to claim 5, wherein a space is provided between said film and said surface of said container having said ventilation apertures.

11. (Amended) A refrigerator comprising:

a chamber for storing foods;

a blower for conveying a chilled air throughout said chamber; and

a sterilizer comprising:

an anti-microbial material including a base ingredient and a volatile anti-microbial agent impregnated in said base ingredient;

an air-permeable capsule encapsulating said anti-microbial material;

a container having ventilation apertures provided in a surface thereof, said capsule being accommodated with said container; and

a peelable film provided over said surface of said container having said ventilation apertures;

wherein said sterilizer is located in a chilled-air passage for channeling the chilled air conveyed by said blower.

12. (Amended) A refrigerator comprising:

a vegetable cooling chamber for storing at least one of vegetables and fruits; and

a sterilizer comprising:

an anti-microbial material including a base ingredient and a volatile anti-microbial agent impregnated in said base ingredient;

an air-permeable capsule encapsulating said anti-microbial material;

a container having ventilation apertures provided in a surface thereof, said capsule being accommodated within said container; and

a peelable film provided over said surface of said container having said ventilation apertures;

wherein said sterilizer is located in said vegetable cooling chamber.

14. (Amended) The sterilizer according to claim 6, wherein a space is provided between said film and said surface of said container having said ventilation apertures.

15. (Amended) The sterilizer according to claim 7, wherein a space is provided between said film and said surface of said container having said ventilation apertures.

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REMARKS

The above amendments have been submitted in order to generally place the application in a preferred form.

Specifically, the claims have been amended to clarify the present invention, to be placed in a preferred form, and to remove some language not believed necessary for patentability. To aid the Examiner's review of these changes, a marked-up copy of the claims has been submitted, and the marked-up claims are captioned "**Version with markings to show changes made**". The claims include the same changes as are indicated in the marked-up copy of the original claims.

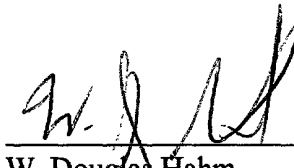
In addition, in order to make necessary editorial corrections, the entire specification and abstract have been reviewed and revised. As the revisions are quite extensive, the amendments to the specification and abstract have been incorporated into the attached substitute specification and abstract. For the Examiner's convenience, a copy of the marked-up original specification and abstract is also enclosed, and the marked-up pages are captioned "**Version with markings to show changes made**". The substitute specification and abstract includes the same changes as are indicated in the marked-up copy of the original specification. No new matter has been added by the revisions. Entry of the substitute specification is thus respectfully requested.

The Examiner is now requested to make a full examination on the merits of the amended application.

Respectfully submitted,

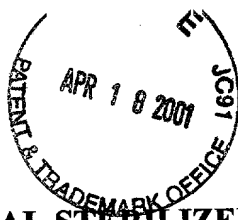
Kahoru TSUJIMOTO et al.

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April 18, 2001



ANTI-MICROBIAL STERILIZER AND REFRIGERATOR HAVING ANTI-MICROBIAL STERILIZER

Technical Field

[0001] The present invention relates to an anti-microbial sterilizer having an antibacterial-sterilizing function used in a refrigerator and a refrigerator equipped with the sterilizer.

Background Art

[0002] Refrigerators successfully generate low-temperature preservative environmental conditions therein for reducing the growth of microbial spores but fail to provide a favorable sterilizing effect of destroying living microorganisms and bacteria. One sterilizer is implemented by mixing and impregnating an anti-microbial agent with a resin as disclosed in Japanese Patent Laid-open Publication 8-210761.

[0003] Such a conventional sterilizer used in a refrigerator will now be explained referring to the relevant drawing.

[0004] Fig. 8 is a cross sectional view of the refrigerator. As shown, the refrigerator has a housing 1 made of a heat insulating material 2 and comprising a refrigerating chamber 5 at an upper location, a freezing chamber 6 at intermediate location, and a vegetable chamber 7 at a lower location which are separated by two partitions 3 and 4. A blower 9 is provided for forcing, into each chamber, a flow of chilled air generated by a cooler 8 in a refrigerating circuit. A compressor 10 is mounted in the bottom of the housing 1.

[0005] A chilled-air output duct 11 is provided for distributing the chilled air generated in the cooler 8 into the refrigerating chamber 5 by the blower 9. A container 12, which is made of resin material, is installed in the vegetable cooling chamber 7 and particularly, is doped with silver-based anti-microbial agent (not shown).

[0006] According to the above arrangement, any microbes contacting the container 12 may be inhibited from growing by the sterilizing action of the anti-microbial agent doped in the resin material.

[0007] The conventional sterilizer, however, fails to destroy most microbes floating in the air or attached on foods, and exhibits a relatively lower sterilization effect in actual use.

[0008] Also, the conventional sterilizer has no function for increasing the preservability of foods including their nutrients.

Summary of the Invention

[0009] The present invention provides a sterilizer exhibiting a practically higher sterilization effect including preservation of foods without directly contacting them, and provides a refrigerator equipped with the sterilizer.

[0010] The sterilizer according to the present invention comprises:

(a) an air-permeable capsule encapsulating an anti-microbial material therein which has a base ingredient impregnated with a volatile anti-microbial agent;

(b) a less-permeable container having ventilation apertures provided partially thereon for accommodating the capsule; and

(c) a peelable, less-permeable film provided for sealing the ventilation apertures on the container. In action, when the film is removed from the container, a vapor of the anti-microbial agent emitted from the anti-microbial material in the capsule can run through the ventilation apertures of the container and flow into the external atmosphere.

[0011] Accordingly, the surface of foods as well as the air are exposed to and sterilized by the vapor, and the nutrients of the foods can thus be preserved.

[0012] A refrigerator according to the present invention has the sterilizer mounted in a passage of the chilled air. This arrangement can improve the sterilization effect of the surface of foods as well as the air in the refrigerator.

[0013] Another refrigerator according to the present invention has the sterilizer mounted in a chamber thereof. This can improve the sterilization effect of vegetables stored in the chamber and the preservation of the nutrients of any stored food.

Brief Description of the Drawings

[0014] Fig. 1 is a cross sectional view of a sterilizer according to Embodiment 1 of the present invention;

[0015] Fig. 2 is a plan view of a capsule in a sterilizer according to Embodiment 2 of the present invention;

[0016] Fig. 3 is a cross sectional view of a sterilizer according to Embodiment 3 of the present invention;

[0017] Fig. 4 is a cross sectional view of a sterilizer according to Embodiment 4 of the present invention;

[0018] Fig. 5 is a cross sectional view of a sterilizer according to Embodiment 6 of the present invention;

[0019] Fig. 6 is a cross sectional view of a refrigerator equipped with a sterilizer according to Embodiment 7 of the present invention;

[0020] Fig. 7 is a cross sectional view of a refrigerator equipped with a sterilizer according to Embodiment 8 of the present invention; and

[0021] Fig. 8 is a cross sectional view of a conventional refrigerator.

Detailed Description of the Invention

[0022] A sterilizer and a refrigerator according to embodiments of the present invention will be described referring to the accompanied drawings. Like components are denoted by like numerals as those explained with the prior art and will be described in no more detail.

(Embodiment 1)

[0023] Fig. 1 is a cross sectional view of a sterilizer according to Embodiment 1 of the present invention.

[0024] A sterilizer 13 comprises a container 14, a cover 15 closing the upper opening of the container 14, and a capsule 16 installed in the container 14. The capsule 16 is filled with an anti-microbial material 17 which is made of a volatile anti-microbial agent 19 impregnated in a base material 18.

[0025] The capsule 16 has two ends welded together to form a double seal for encapsulating the anti-microbial material 17 therein. The capsule 16 is accommodated in the container 14 and distanced by a space 20 from the cover 15.

[0026] The anti-microbial agent 19 may be selected from aliphatic esters and aromatic esters like ester isothiocyanate, and more preferably, allyl isothiocyanate for providing higher effects of anti-microbial property and food preservability. The base material 18 may be natural resins, porous powder substances, viscous substances, paper, and unwoven fabrics. Preferably, the base material 18 is rosin ester, which is capable of holding and gradually emitting the allyl isothiocyanate and is high in physical stability and safety.

[0027] The capsule 16 is made of an air-permeable film adapted and shaped for allowing the allyl isothiocyanate, the anti-microbial agent 19, in the anti-microbial material 17 to be emitted as vapor. More particularly, the film may have a multiplicity of tiny apertures through which the allyl isothiocyanate in vapor is emitted. Alternatively, the film may be highly breathable for the evaporated allyl isothiocyanate. This permits the allyl isothiocyanate, the anti-microbial agent 19, to be emitted at a proper concentration. The material of the capsule 16 may be a combination of unwoven fabric and air-permeable film such as polyethylene or polypropylene film bonded together.

[0028] The cover 15 has ventilation apertures 21 provided thereon passing the vapor of the anti-microbial agent 19. A peelable, less-permeable film 22 is welded to the upper end

including the opening of the container 14 to hang over the ventilation apertures 21. The film 22 may be made of an aluminum foil or an aluminum-evaporated film.

[0029] Table 1 illustrates a result of testing the anti-microbial effect of the sterilizer. The test is conducted with spores of microbes suspended in a box of 50cm in length, 50cm in width, and 50cm in height. Then, two conditions are developed. One is that the box is impregnated with a silver-based anti-microbial agent, which is thus applied to the inner wall of the box, and another is that the box is filled with a given concentration of the allyl isothiocyanate. The spores of microbes in the air are sampled using filters before and after the beginning of the test, cultured, and then, counted as colonies. As a result, the sterilizer of the embodiment exhibits one hundred times as high an anti-microbial effect (spore reduction) as the conventional sterilizer, which exhibits much improvement.

(Table 1)

	Conventional	Embodiment
Number of Spores before Test (Numbers / L)	2.0×10^4	2.0×10^4
Number of spores after Test (Numbers / L)	2.0×10^3	10
Spore Reduction	1/10	1/1000

[0030] As seen from the results in the table, the sterilizer 17 of this embodiment emits the anti-microbial agent 19 of allyl isothiocyanate filled in the capsule 16 through the ventilation apertures 21 into an external atmosphere when the less-permeable film 22 has been removed.

[0031] The anti-microbial agent 19 inhibits microbes floating in the air or attached to the surface of foods from growing and thus exhibits a higher sterilization effect than the conventional one even without a direct contact.

[0032] Also, attenuating ethylene and minimizing the decomposition of Vitamin C by allyl isothiocyanate enlarge the preservation of foods, particularly vegetables and fruits, through protecting their nutrients and inhibiting them from degrading with age.

[0033] Since the opening of the container 14 is sealed closely with the less-permeable film 22 before its usage, the anti-microbial agent 19 does not leak. Therefore, the sterilizer 13 can instantly exhibit its sterilizing effect with ease just upon the film 22 being removed.

[0034] The space 20 between the capsule 16 and the cover 15 avoids any stress or pressure from directly being exerted on the capsule 16 when the cover 15 is welded to seal the container 14. This allows the base material 18 encapsulating the anti-microbial agent 19 from leaking out, hence increasing the reliability of the sterilizer 13.

(Embodiment 2)

[0035] Fig. 2 is a plan view of the capsule in a sterilizer according to Embodiment 2 of the present invention. A capsule 23 is a roll of a thermally-bonded air-permeable film of unwoven fabric thermally-sealed at both ends by double-sealing of a first seal 24 and a second seal 25. It is filled with an anti-microbial material 17.

[0036] The capsule 23 is thermally-sealed in a manner corresponding to the material thereof. In this embodiment, the first seal 24 is double-sealed at a sealing temperature of 135°C and under a pressure of 4kgf/cm² while the second seal 25 is welded at a sealing temperature of 120°C and under a pressure of 1kgf/cm².

[0037] In action, when the anti-microbial material 17 is liquid or has a lower viscosity, it may undesirably leak out from both ends of the capsule 23. However, the double-sealing at each end positively prevents the anti-microbial material 17 from leaking out, hence increasing the reliability of the sterilizer.

(Embodiment 3)

[0038] Fig. 3 is a cross sectional view of a sterilizer according to Embodiment 3 of the present invention.

[0039] A sterilizer 26 has an anti-microbial material 27 encapsulated in a capsule 16. A base material 28 is a mixture of a liquid or low viscous material and an additive 29 which is a lower temperature thermoset. The anti-microbial material 27 includes the base material 28 impregnated with a volatile anti-microbial agent 19. The additive 29 may preferably be a paraffin wax for safety and stability.

[0040] Even when the base material 28 of the anti-microbial material 27 is liquid or has a lower viscosity, the impregnated additive 29, which is a lower temperature thermoset, can guarantee a desired viscosity of the anti-microbial material 27. Accordingly, the anti-microbial material 27 stays in a solid form or a non-fluid gel form at an ordinary temperature and can thus be prevented from leaking out from the capsule 16, hence improving the handling of the sterilizer.

(Embodiment 4)

[0041] Fig. 4 is a cross sectional view of a sterilizer according to Embodiment 4 of the present invention.

[0042] As shown in Fig. 4, a sterilizer 30 has an anti-microbial material 31 encapsulated in a capsule 16. A base material 32 of the anti-microbial material 31 is doped with an additive 29, e.g., a paraffin wax, which is a lower temperature thermoset. The anti-microbial material 31 also includes a volatile anti-microbial agent 19 and a volatile aromatic substance 33. The aromatic substance 33 may preferably be selected from a variety of herbs having a function of masking irritating odors of the anti-microbial agent 19. More preferably, the aromatic substance 33 may be peppermint oil, which exhibits a synergistic sterilization effect together with allyl isothiocyanate. Also, a space 34 is provided between a film 22 and a cover 15 for the anti-microbial material 31.

[0043] The space 34 above the anti-microbial material 31 including the anti-microbial agent 19 and the aromatic substance 33 can hold the aromatic substance 33, which is lower in the volatility than the anti-microbial agent 19, at a high gaseous saturation. Accordingly, the odors of allyl isothiocyanate generated when the less-permeable film 22 is removed can be diminished by the masking effect of peppermint oil, the aromatic substance 33. Also, the allyl isothiocyanate and the peppermint oil in a combination can exhibit a synergistic effect for improving the sterilization.

(Embodiment 5)

[0044] Table 2 illustrates a composition of a sterilizer according to Embodiment 5 of the present invention.

[0045] An aromatic substance 33 is contained in an anti-microbial material 31 at a higher concentration than an anti-microbial agent 19 in the material 31.

[0046] Also, the ratio of peppermint oil to allyl isothiocyanate is increased for masking irritating odors of the highly volatile allyl isothiocyanate. This allows the low volatile peppermint oil to mask the highly volatile allyl isothiocyanate thus minimizing the odors of allyl isothiocyanate. Moreover, the peppermint oil and the allyl isothiocyanate in a combination can exhibit a synergistic effect for the sterilization.

(Table 2)

Components	Content (wt. %)
Allyl Isothiocyanate	15.6
Peppermint Oil	19.6
Rosin Ester	54.5
Paraffin Wax	10.4

(Embodiment 6)

[0047] Fig. 5 is a cross sectional view of a sterilizer according to Embodiment 6 of the present invention. A sterilizer 35 has an anti-microbial material 36 encapsulated in a capsule 16. A second aromatic substance 37 is different than the first volatile aromatic substance 33. While the first volatile aromatic substance 33 is an herb type such as peppermint oil, the second aromatic substance 37 is a citrus type such as a lemon extract. Accordingly, the anti-microbial material 36 contains two, herb and citrus, different aromatic substances 33 and 37.

[0048] For enhancing the sterilization effect, the ratio of the anti-microbial agent 19 such as allyl isothiocyanate, which generates irritating odors needs to be increased. Although a larger amount of odors is emitted from the anti-microbial agent 19, a combination of the herb aromatic substance 33, peppermint oil, and the citrus aromatic substance 37, lemon extract, successfully mask the odors.

[0049] For masking more odors from the anti-microbial agent 19 by one type of aromatic substance, the herb aromatic substance 33 has two increases. The effect of the increase in aromatic substance 33 for masking the odors may accordingly saturate, or the scent of the aromatic substance 33 itself may accordingly turn to an odor discouraging users.

[0050] As the two different aromatic substances 33 and 37 are mixed up, they cooperate to favorably mask the odors released from the anti-microbial agent 19 without emphasizing the scent of the original aromatic substance 33. The extra aromatic substance 37 is a type of citrus, and the scent can soften the atmosphere for masking the odors with the counter scent of the herb aromatic substance 33. Also, the aromatic substance 37 of a citrus type, e.g., a lemon extract, has a sterilization effect and can contribute to the synergistic effect of sterilization.

(Embodiment 7)

[0051] Fig. 6 is a cross sectional view of a refrigerator according to Embodiment 7 of the present invention. A refrigerator 38 has a sterilizer 30 mounted at an appropriate location in a chilled-air-output duct 11 thereof.

[0052] In action, the chilled air produced by a cooler 8 is conveyed by a blower 9 through the chilled-air-output duct 11 into a refrigerating chamber 5 for refrigeration. While the chilled air conveyed in the chilled-air-output duct 11 runs through the sterilizer 30, an anti-microbial agent 19, e.g., allyl isothiocyanate, and an aromatic substance 33, e.g., peppermint oil, are distributed in an evaporated form into the refrigerating chamber 5. The anti-microbial agent 19 and the aromatic substance 33 are then conveyed from the refrigerating chamber 5 via a circulating passage of the chilled air into a freezing chamber 6 and a vegetable cooling chamber 7. Any microbes floating in the air and attached on foods in the refrigerator 38 are exposed to the chilled air and sterilized by the anti-microbial agent 19. Simultaneously, the aromatic substance 33 reduces irritating odors of the anti-microbial agent 19. This allows a user to be free from the odors when opening the door of the refrigerator 38.

[0053] The sterilizer 30 according to this embodiment is located in the chilled-air output duct 11. If it is unfavorable to be under a lower temperature, the sterilizer 30 may be mounted in a chilled-air input duct. Alternatively, the sterilizer 30 may be located not in the duct but at any possible location where the chilled air runs.

(Embodiment 8)

[0054] Fig. 7 is a cross sectional view of a refrigerator according to Embodiment 8 of the present invention. A vegetable cooling chamber 40 is separately provided in a refrigerator housing 39. A sterilizer 30 is mounted at the back top of a container 12.

[0055] In action, the inner space of the vegetable cooling chamber 40 is filled with an evaporated anti-microbial agent 19, e.g., allyl isothiocyanate, and an aromatic substance 33,

e.g., peppermint oil, both of which are emitted from the sterilizer 30. The anti-microbial agent 19 and the aromatic substance 33 dissipating in substantially a closed space of the vegetable cooling chamber exhibit a higher sterilization effect for destroying microbes floating in the air and attached on foods, such as vegetables and fruits, in the vegetable cooling chamber. Also, an effect of minimizing ethylene gas and the decomposition of Vitamin C by the allyl isothiocyanate prevent vegetables and fruits from decaying, and their nutrients can successfully be preserved. Furthermore, the odor of the anti-microbial agent 19 is reduced by the masking effect of the aromatic substance 33 and thus hardly disturb the user when opening the door of the refrigerator.

[0056] The sterilizer 30 according to this embodiment is located in the vegetable cooling chamber 40. However, it may also be mounted with an equal effect in any compartment or container which is not dedicated to but assigned for storing vegetables and fruits in the refrigerator.

[0057] Table 3 illustrates results of a test of the sterilization effect in the vegetable cooling chamber of the refrigerator according to this embodiment. The test was conducted with two different conditions, including a first one where the vegetable cooling chamber was protected with a conventional silver-based anti-microbial agent, and a second one with the sterilizer of this embodiment. In each condition, the vegetable cooling chamber is filled with a pack of strawberries. The pack contains a mold-grown strawberry in the center thereof. The growth of the mold with time is then monitored. As a result, the conventional condition exhibits the growth of mold on neighbor strawberries, and the condition according to this embodiment does not exhibit that. That is, the sterilization effect of the sterilizer according to this embodiment is higher than that of the conventional one.

(Table 3)

	Conventional	This Embodiment
Growth of Mold before Test	-	-
Growth of Mold after Test	+++	-

Note) -: No growth, +++: Significant growth

Industrial Applicability

[0058] The present invention relates to an anti-microbial sterilizer having an antibacterial-sterilizing function used in a refrigerator, and a refrigerator equipped with the sterilizer. The sterilizer according to the present invention comprises an anti-microbial material having a base ingredient impregnated with a volatile anti-microbial agent, an air-permeable capsule encapsulating the anti-microbial material, a less-permeable container having ventilation apertures provided partially thereon for accommodating the capsule, and a peelable, less-permeable film provided on the container at the ventilation apertures. In action, the anti-microbial agent released into an external atmosphere can destroy any microbes floating in the air and attached on foods and inhibit their spores from growing.

[0059] In a refrigerator having the sterilizer mounted in a passage of chilled air, the anti-microbial agent emitted from the sterilizer is conveyed throughout the refrigerator with the flow of the chilled air. The sterilizing effect can kill any microbes floating in the air and attached on foods.

[0060] Also in a refrigerator having the sterilizer mounted in a chamber thereof where vegetables are stored, the anti-microbial agent emitted from the sterilizer is conveyed throughout the chamber. The sterilizing effect can kill any microbes floating in the air and

attached on foods, and can reduce ethylene gas and the loss of nutrients including Vitamin C from vegetables and fruits.

[0061] Moreover, the anti-microbial material may be doped with an aromatic substance. The aromatic substance masks the anti-microbial agent and thus reduces irritating odors of the agent in the refrigerator.



ABSTRACT OF THE DISCLOSURE

A sterilizer includes an anti-microbial material having a base ingredient impregnated with a volatile anti-microbial agent, an air-permeable capsule encapsulating the anti-microbial material, and a container accommodating the capsule and having ventilation apertures provided on a surface thereof for accommodating the capsule. The sterilizer also has a peelable film provided above the container to seal the ventilation apertures. When the film is removed from the container, a vapor of the anti-microbial agent emitted from the anti-microbial material in the capsule can flow through the ventilation apertures on the container and flow into the external atmosphere. That improves the effects of sterilizing the surface of food as well as the air and of preserving the nutrient of food in, for example, a refrigerator.

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Fig. 1

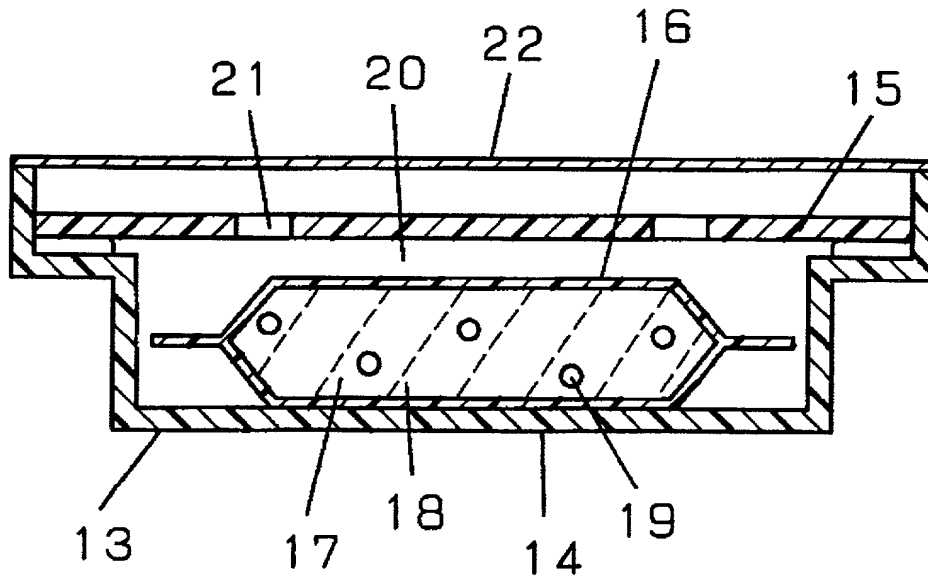


Fig. 2

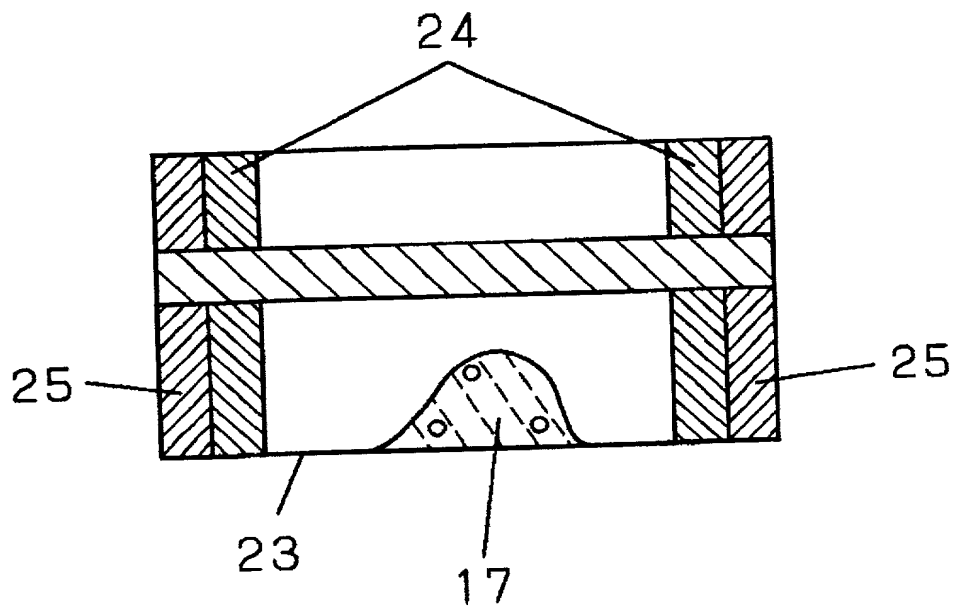


Fig. 3

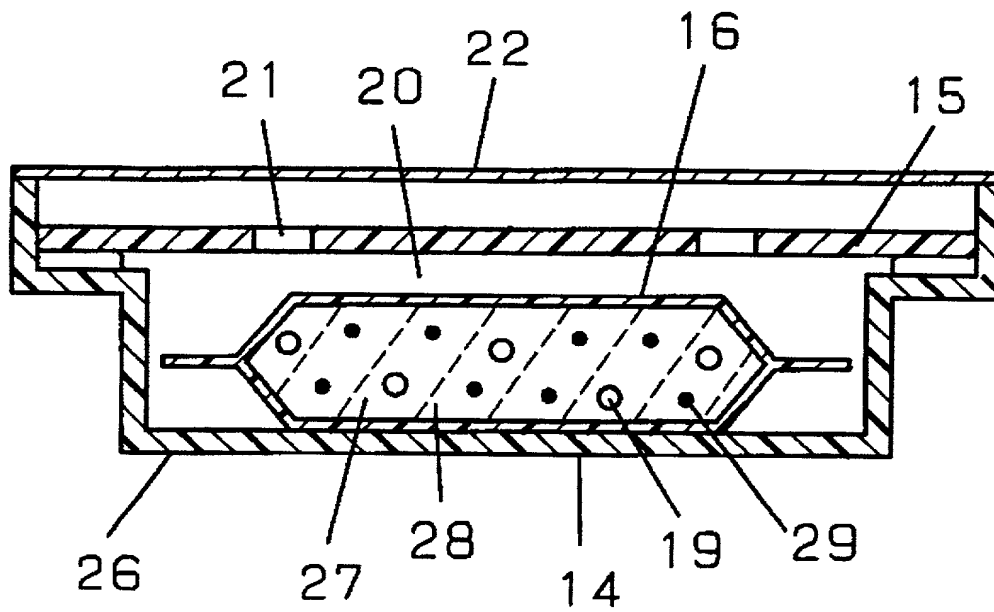


Fig. 4

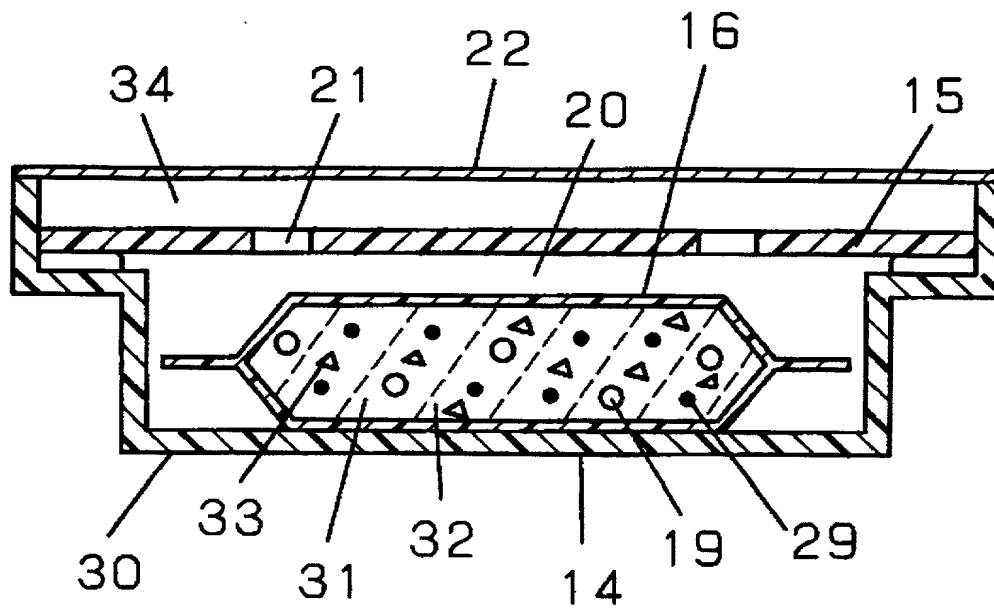


Fig. 5

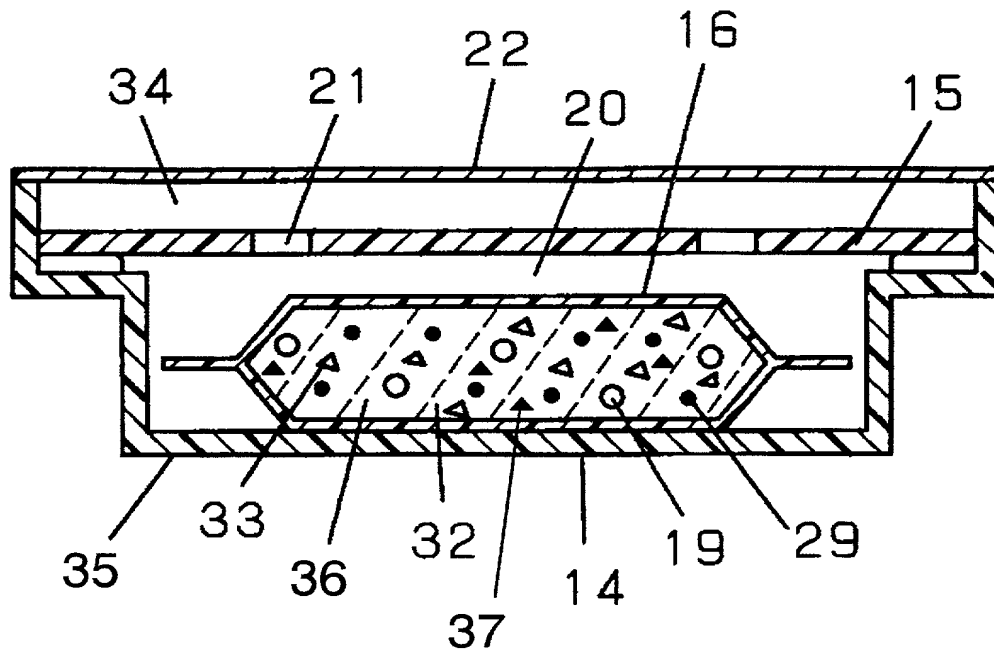


Fig. 6

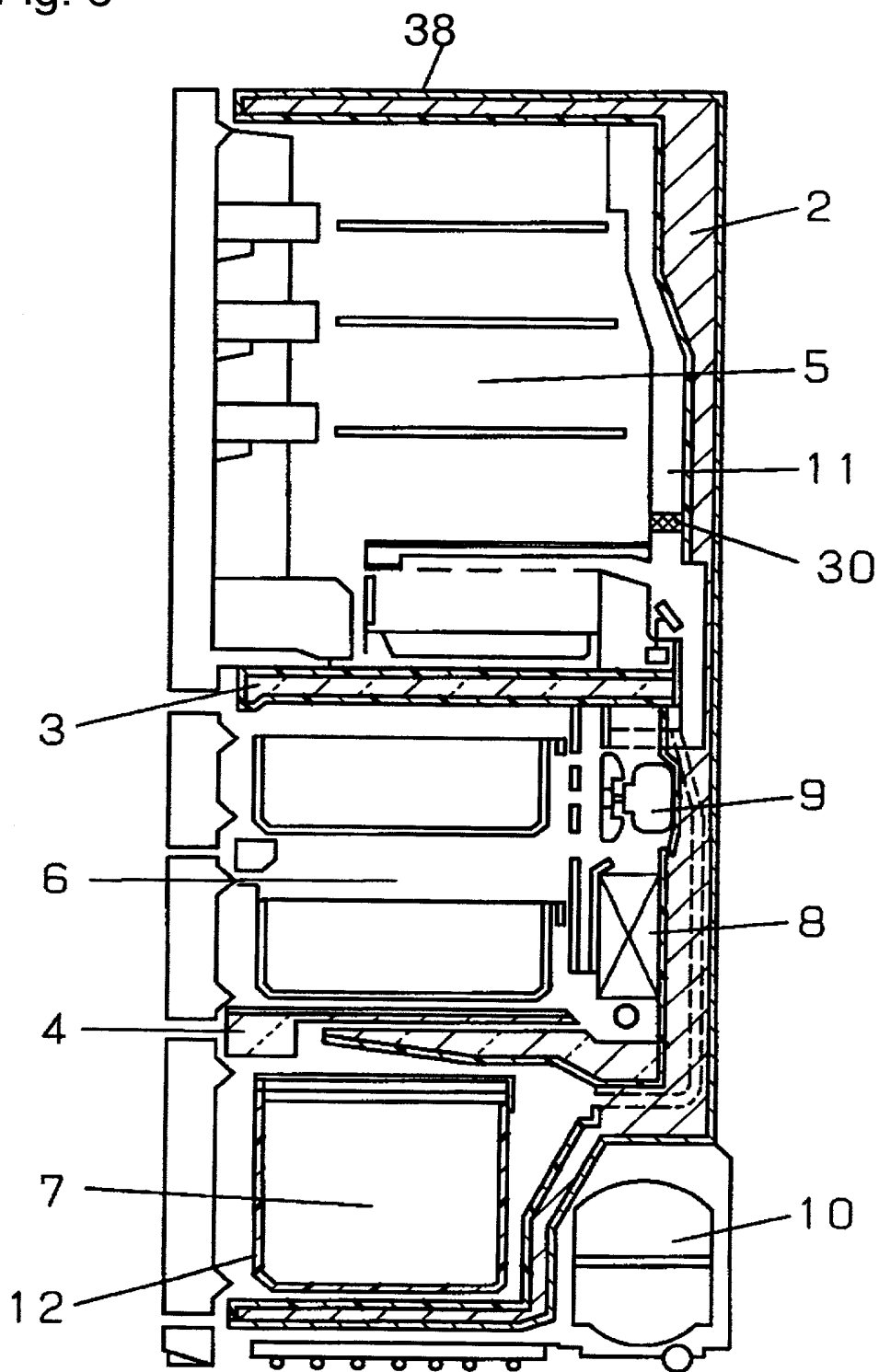


Fig. 7

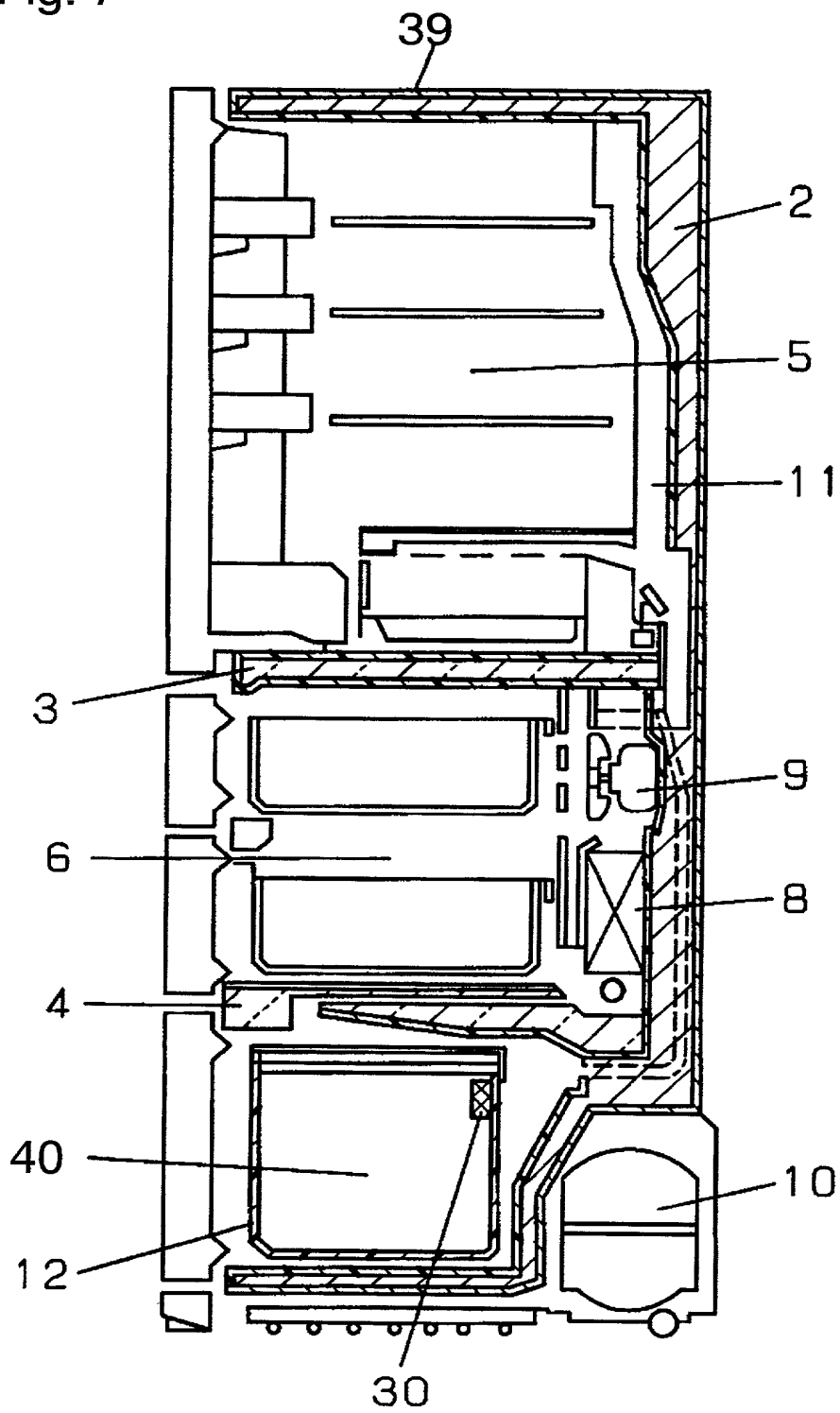
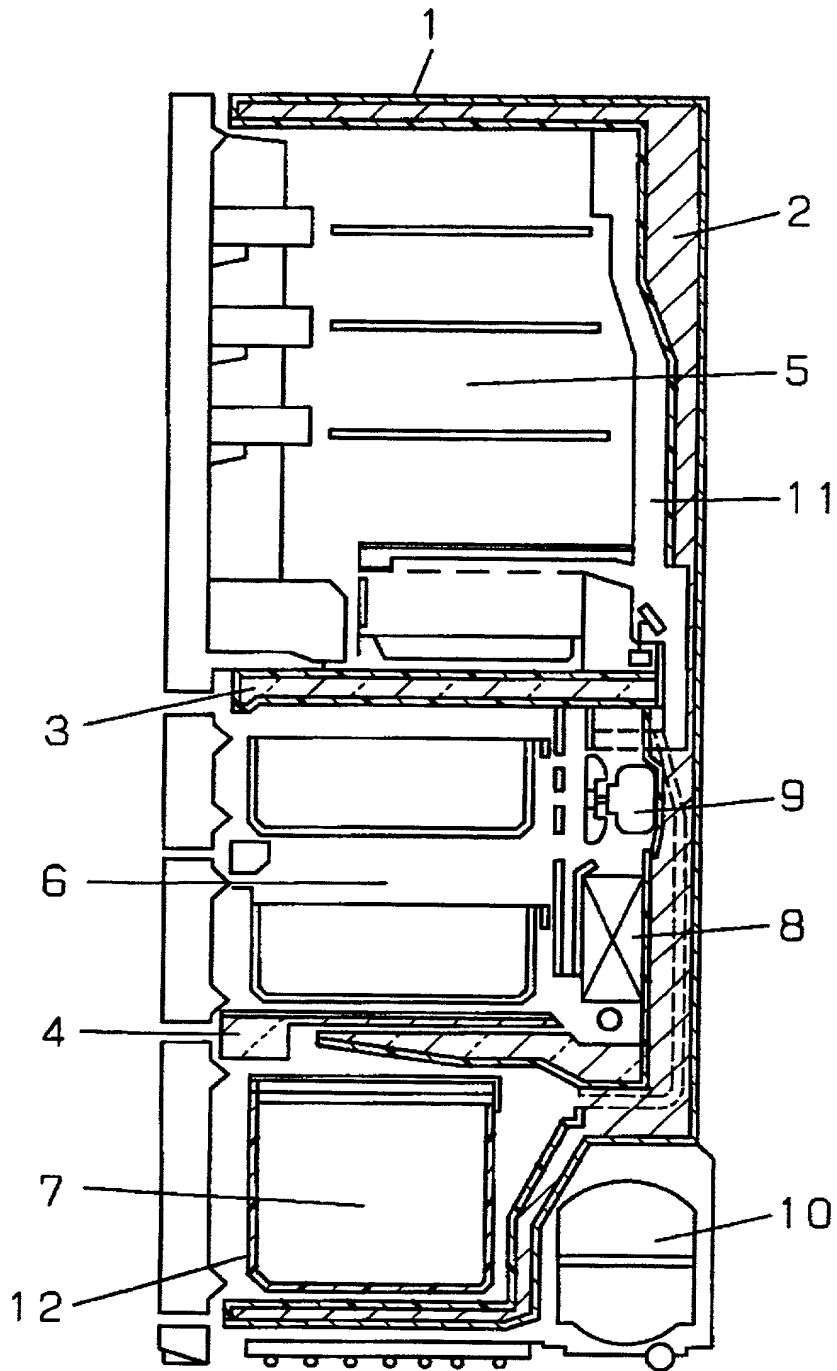


Fig. 8

Prior Art



DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

☐ Original ☐ Supplemental ☐ Substitute ☒ PCT ☐ DESIGN

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: ANTI-MICROBIAL STERILIZER AND REFRIGERATOR HAVING IT

of which is described and claimed in:

- ☐ the attached specification, or
☐ the specification in application Serial No. 09/763,964, filed February 28, 2001, and with amendments through the Preliminary Amendment filed February 28, 2001
☒ the specification in International Application No. PCT/JP00/04967, filed July 26, 2000, and as amended on _____ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
Japan	11-211668	July 27, 1999	YES

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Warren M. Cheek, Jr., Reg. No. 33,367; Nils Pedersen, Reg. No. 33,145; Charles R. Watts, Reg. No. 33,142; and Michael S. Huppert, Reg. No. 40,268, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., as well as any other attorneys and agents associated with Customer No. 000513, to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys and agents named herein to accept and follow instructions from Matsushita Technical Information Services Co., Ltd. as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

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I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1st Inventor Kahoru Tsujimoto Date May 15, 2001
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5th Inventor _____ Date _____
6th Inventor _____ Date _____

The above application may be more particularly identified as follows:

U.S. Application Serial No. 09/763,964 Filing Date February 28, 2001

Applicant Reference Number P23444-01(I.S.Ynakao) Atty Docket No. 2001_0210A

Title of Invention ANTI-MICROBIAL STERILIZER AND REFRIGERATOR HAVING IT